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| 10/076,099 | 02/15/2002 | Wayne L. Johnson | P 273243 PC0033A Reg | 8536 |
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| PILLSBURY WINTHROP, LLP | | | MCDONALD, RODNEY GLENN | |
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| MCLEAN, VA 22102 | | | PAPER NUMBER | |

1753

DATE MAILED: 04/01/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/076,099

Applicant(s)

JOHNSON ET AL.

Examiner

Rodney G. McDonald

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 10 January 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-27 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 1-18 is/are allowed.
- 6) ☒ Claim(s) 19 and 20 is/are rejected.
- 7) ☒ Claim(s) 21-27 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- ☒ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- ☐ Notice of Informal Patent Application (PTO-152)
- ☐ Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 19 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ohara et al. (U.S. Pat. 6,277,756) in view of Otsubo et al. (U.S. Pat. 4,808,258).

Regarding claim 19, Ohara et al. teach an apparatus in Fig. 2 that has a chamber enclosing a plasma region. (Column 3 lines 55-56) The chamber has a gas injection assembly in the form of a gas introduction inlet 22 having gas lines 22a, 22b, and 22c for introducing a plurality of different gases. Each of the gas lines 22a, 22b, and 22c has a change-over valve 24a, 24b, and 24c for controlling the introduction of each of the gases to the chamber 21. (Column 3 lines 58-60) During a first time period etching gas

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is introduced. (Column 4 lines 20-34) During a second time period a deposition gas is introduced. (Column 4 lines 35-52) Two electrodes 26a, 26b are connected to two RF power supplies for generating an electric field. (Column 4 lines 1-5) The electrode 26a provides support for the substrate 1. (Column 4 lines 1-5) Gas is exhausted through the exhaust outlet 23. (Column 4 lines 12-14) The gas exhausted inherently requires a vacuum pump.

The differences between Ohara et al. and the present claims is that the electromagnetic field having an energy level, which varies cyclically between at least two values each sufficient to maintain the plasma is not discussed and the dc self bias is not discussed.

Otsubo et al. teach supplying a gas to produce a plasma for etching an aluminum film. (Column 3 lines 12-24) The plasma processing method uses amplitude modulated high frequency voltage. **(Compare to providing an RF electromagnetic field to the chamber)** In this method, a gas pressure is made higher as compared with the conventional plasma processing method. Further, a high-frequency voltage V_2 lower than the conventional voltage V_1 (shown in FIG. 2) is applied between electrodes for a period t_1 , as shown in FIG. 3. **(Compare to providing the electromagnetic field at two values. This representing the first)** Since the gas pressure is high, the ion energy at the period t_1 is low, but the discharge current is increased at this period. Accordingly, the energy of an electron flowing from each electrode to a plasma is lowered, but the number of such electrons is increased. Thus, the production of a

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radical, which contributes to etching, is also increased. **(Compare to performing a different treatment process)** (Column 3 lines 47-61)

At a period t_2 , a high-frequency voltage V_3 higher than the conventional voltage V_1 is applied between the electrodes, under a high gas pressure. **(Compare to providing the electromagnetic field at two values. This representing a second value)** Thus, ion energy necessary for removing the aluminum oxide film and for forming the sidewall is obtained. **(Compare to performing a different treatment process)** The ion energy distribution in the above case is schematically shown in FIG. 4. (Column 3 lines 62-68)

The high frequency voltage is at 13.56 MHz. (Column 6 line 55) **(Compare to providing an RF electromagnetic field to the chamber)**

The amount and energy of the ion can be changed by changing the ratio t_1/t_2 and voltage V_3 . **(Compare to Applicant's required varying of the energy level during different repetition periods during respectively different time intervals.)**

In Fig. 8 a processing chamber is shown with a gas inlet 11 and gas outlet 12. (Column 6 lines 43-45) The gas outlet inherently requires a pump to maintain vacuum for plasma processing. This is also recognized in other embodiments, which require an evacuating means (not shown). (Column 8 line 68; Column 9 line 1) An RF power source is provided in the form of a standard signal generator 21 at a frequency of 13.56 MHz. (Column 6 lines 55-59) The signal generator produces an electromagnetic field which creates a plasma the field has an energy level that varies cyclically between at least two values as seen in Figure 3. The values are V_2 and V_3 . (See Fig. 3)

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With regard to the DC self-bias, since RF bias is applied to the substrate the voltage produces a dc self bias which varies between two values V_1 and V_2 . (See voltages discussed above)

The motivation for utilizing an electromagnetic field having an energy level, which varies cyclically between at least two values each sufficient to maintain the plasma is that it allows for adjustment of the kind of ion and radical formed in the plasma.
(Column 1 lines 66-68)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified Ohara et al. by utilizing an electromagnetic field having an energy level, which varies cyclically between at least two values each sufficient to maintain the plasma as taught by Otsubo et al. because it allows for adjustment of the kind of ion and radical formed in the plasma.

Allowable Subject Matter

Claims 1-18 are allowed.

Claims 21-27 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter:

Claims 1-18 are allowable over the prior art of record because the prior art of record does not teach the claimed subject matter including introducing a first process gas into the reactor chamber during a first time period and introducing a second process

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gas having a different composition than the first process gas during a second time period which the first time period and causing the electromagnetic field to have an energy level which varies cyclically between at least two values each sufficient to maintain the plasma, such that each energy level value is associated with performance of a respectively different treatment process on the substrate.

Claims 21-27 are indicated as being allowable because the prior art of record does not teach the gas injection assembly comprising a gas injection plate provided with a plurality of gas injection nozzles; a plurality of gas injection valves, each configured to supply at least one of the first or second process gases to at least one respective one of the nozzles; and a plurality of valve controllers coupled to the plurality of gas injection valves to cause the first or second gas to be supplied to each of the nozzles in an intermittent manner.

Response to Arguments

Applicant's arguments filed 1-10-05 have been fully considered but they are not persuasive.

Applicant has incorporated indicated allowable subject matter in claims 1-18 and these claims have been allowed. Claims 21-27 have also been indicated as being allowable based upon the limitations set forth in claim 27, which the currently applied prior art does not suggest.

Applicant's arguments with claims 19 and 20 have been considered. A new ground of rejection has been applied to these claims. Applicant had previously argued that the prior art does not suggest "...a gas injection assembly immediately proximate

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the plasma region, said gas injection assembly configured to introduce a first process gas into said chamber during a first time period and introduce a second process gas having a different composition than the first process gas during a second time period which follows the first time period..." Newly applied reference to Ohara et al. is urged to suggest a gas injection assembly that introduced a first process gas at a first time period and introduces a second process gas during a second time period, which follows the first time period. The different gases perform etching and deposition respectively. Valves control the different inputs of the gases.

This action will be made NON-Final based on the new rejection of the claims.

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Rodney G. McDonald whose telephone number is 571-272-1340. The examiner can normally be reached on M- Th with Every other Friday off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam X. Nguyen can be reached on 571-272-1342. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Rodney G. McDonald
Primary Examiner
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RM
March 28, 2005